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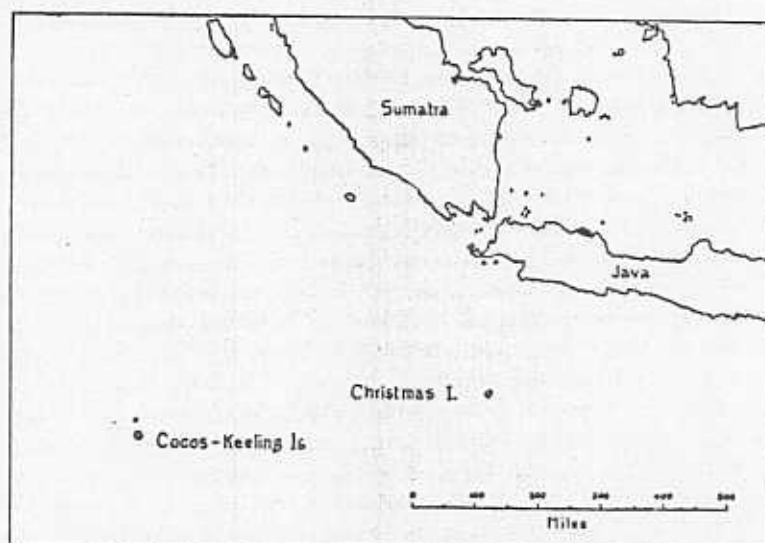
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A Note on the Cocos-Keeling Islands¹

By C. A. GIBSON-HILL, M.A.

Plates Nos. 1-8 between pages 16 & 17.

The Cocos-Keeling Islands lie in the eastern portion of the Indian Ocean, between $11^{\circ} 49'$ and $12^{\circ} 12'$ south of the equator, and $96^{\circ} 49'$ and $96^{\circ} 56'$ east of Greenwich. They are approximately 600 miles south-west of Java Head, and 530 miles from Christmas Island, the nearest point of land (*see* map 1). The group consists of an atoll of about 25 islands surrounding a pear-shaped lagoon, 7 miles wide and 9 miles long, and a single island, 1,250 yards wide and 2,250 yards long, fifteen miles further north.



MAP 1. Sketch map showing the position of the Cocos-Keeling Islands and Christmas Island in relation to Sumatra and Java.

The group has been known since the beginning of the seventeenth century. It is believed to have been discovered in 1609 by William Keeling a merchant captain sailing for the Hon'ble East India Company, while homeward bound from

¹. Summaries of the physical features etc. of the Cocos-Keeling Islands also appear in two earlier papers (Gibson-Hill, *Journ. Malay Br. Roy. Asiat. Soc.* 1947, and *Ibis* 1949), from which some of the passages in the present account have been taken.

Bantam in western Java. His name has certainly been popularly associated with the atoll since at least the middle of the seventeenth century. On the other hand there is no reference to the islands in the abridged version of the journal of his voyage which Samuel Purchas published in *Purchas His Pilgrimes* in 1625.

The northern island has been called *Keeling Island* or *North Keeling* throughout its recorded history. The main atoll has borne several different names. From the references in William Dampier's *New Voyage Round the World* (1697, chap. 17) it would seem that English sailors called it *Cocos* as early as the late seventeenth century at least. The Dutch at this time and later usually referred to it as the *Triangular Islands*, and mark it thus on their charts. Early in the nineteenth century the main atoll became known as the *Borneo Coral Reefs*, from the name of the boat in which the founder of the present settlement reached it. He himself, in his journal, always refers to it as *Keeling's Islands* or *Keeling Island*. The use of a collective title, to include both the north island and *Cocos*, dates from the work of Horsburgh, who evolved the present name of the *Cocos-Keeling Islands* in 1805. In the latter part of the nineteenth century the owner changed this to the less euphonic *Keeling Cocos Islands* while the Eastern Archipelago Pilot, Vol. 2, renders it as the *Cocos or Keeling Islands*. *Cocos-Keeling* is, however, the form accepted in the earlier Colonial Reports (1885-1904), and the one used by the majority of the travellers and naturalists who have visited the group, including H. O. Forbes (1885), H. B. Guppy (1889) and in most instances F. Wood-Jones (1909 and 1912). As this name can also claim priority it is used in my previous papers, and again here.

The group was uninhabited at the time of its discovery, and remained without permanent occupants until 1827, when John Clunies-Ross, a Scottish seaman, and Alexander Hare, an English adventurer, established settlements on islands in the main atoll. With them were the crews, mostly men from Sumatra and Java, of their two trading vessels, and an assortment of women from the far eastern ports belonging to Hare. Hare returned to Batavia a few years later, leaving the islands to Clunies-Ross and his family. At the present time his great-great-grandson, John Cecil Clunies-Ross, is the owner of the group. The native population now numbers about 1,800 persons, the majority of whom reside in a village on Pulo Selma, (Home Island).² There are also a few people living on the most northerly island in the atoll, Pulo Luar (Horsburgh Island). Finally there is a relay

2. In 1941 the population was about 1,450; in 1931 about 1,100, and in 1912, 594. A fuller account of this community and its history forms the subject of an earlier paper by the present writer (1947: 140-202).

station for the trans Indian Ocean submarine cable, established in 1901, with a staff of about thirty men, on the neighbouring island of Pulo Tikus (Direction Island). Landing on North Keeling is difficult. Accordingly no permanent settlement has ever been established there, and at the present time it is visited only at wide intervals.

Clunies-Ross and Hare had planned to use the islands as a depot for trade in spices and similar commodities between the Sunda Islands and England. Unfortunately Ross's first voyage home was a marked failure financially, and he concluded that he lacked the capital and temperament required for a successful commercial career. He therefore decided to remain on the atoll, and to live by the export of coconuts, oil and copra. His early trade was mostly with Mauritius and Java, though it would seem that a few voyages were also made to Colombo, and possibly to Singapore. Later, in the time of the second Clunies-Ross (owner 1854-71), the contact with Mauritius ceased and until the turn of the century the islands were almost entirely dependent on the Javanese ports, and occasional boats sailing direct to or from Europe. Trade with Singapore became increasingly important from the late eighteen-nineties onwards. During the World War of 1914-18 J. S. Clunies-Ross lost his schooner, which was stolen by escaping members of the crew of the German cruiser *Emden*, and subsequently sold his only other ocean-going boat. These were not replaced after 1918, and in the inter-war period the islands depended on a part-charter of the vessel supplying the Cable Station on Pulo Tikus. This normally made three trips a year to and from Singapore, by way of Christmas Island. In the early days of the settlement, therefore, ship-jumping fauna and flora might have reached the main atoll from Mauritius or Java. Subsequently the opportunities were largely restricted to Java and Christmas Island, and finally to Singapore and Christmas Island.

Christmas Island lies fairly close to the normal sailing course from the southern entrance of the Sunda Strait. It is not clear when men from Cocos first made a landing on it, but from a comment by H. O. Forbes it must have been before 1878. There is no doubt that it had certain natural attractions for them. There were, as Wood-Jones (1912: 41) puts it, the "vast flocks of absolutely unsuspecting birds" to form a valuable addition to their diet. It was also a useful source of timber for boat-building and other purposes. Wood-Jones even suggests that George Clunies-Ross, who succeeded his father in 1871, often took parties of his men to camp there. Be that as it may, in November 1888, following considerable interest in Christmas Island by the outside world, Andrew, one of George Clunies-Ross's younger brothers, established a small colony of Cocos-Keeling Malays in Flying Fish Cove. The settlement never

reached any appreciable size, and it would seem to have fluctuated in content from time to time, but it continued, with fairly constant contact with the Cocos-Keeling Islands, until August 1899. By this time the Christmas Island Phosphate Company, which had been established in 1896 to work the rich deposits of phosphate on the plateau, was well established on the island.

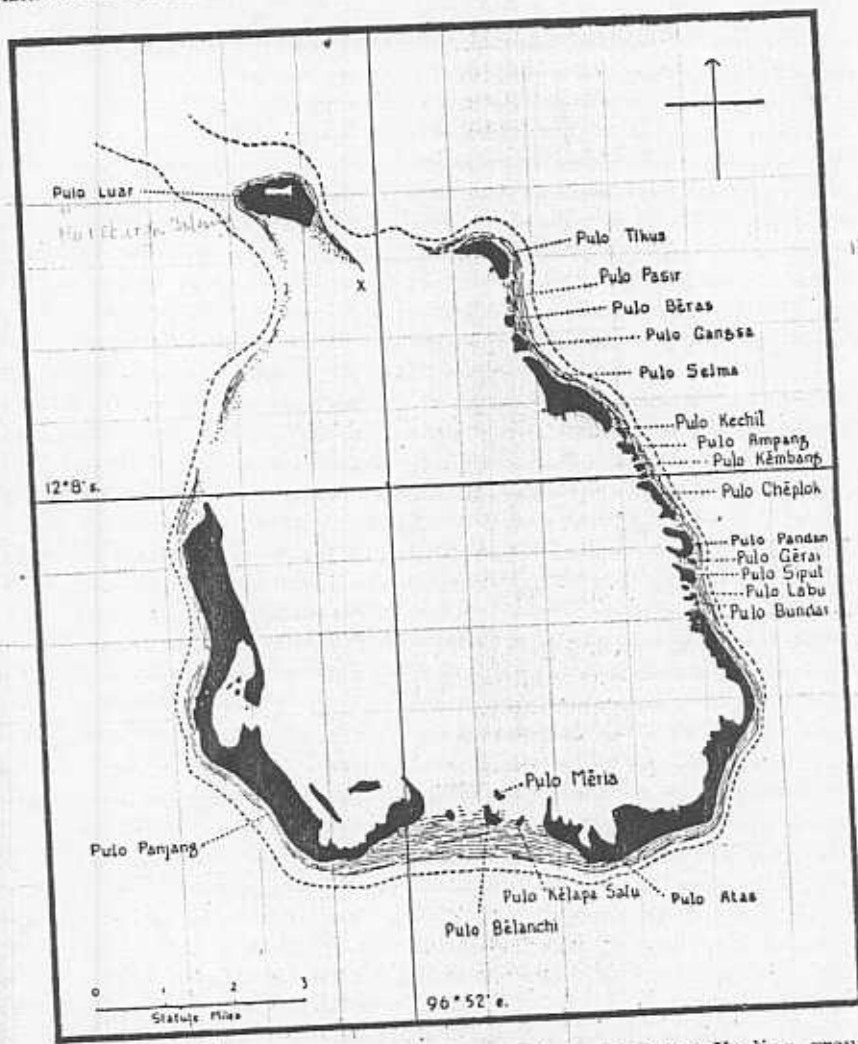
The small party on the fringe of Flying Fish Cove attempted the cultivation, in a desultory manner, of a number of fruit trees, vegetables and spices, the majority of which could not be grown satisfactorily on the Cocos-Keeling Islands. The products, when any were obtained, were sent down to the atoll, together with occasional shipments of the Christmas Island Redwood, *Berrya ammonilla* Roxb., and other timbers of value. In addition they no doubt despatched large quantities of the absolutely unsuspecting birds. It would also seem highly probable that at least a small number of terrestrial invertebrates were carried in these cargoes, but unfortunately there is now no sure means of assessing the extent of Christmas Island's contribution to the Cocos-Keeling fauna by this means. As explained in the introduction, it is not even possible for us to list fully the species common to the two islands. All that does seem probable is that at least the two mosquitoes and the centipede *Scolopendra subspinipes* Leach reached Christmas Island from the Cocos-Keeling Islands (see Gibson-Hill, *Journ. Malay Br. Roy. Asiat. Soc.*, 22 (1), 1949: 87-88). In addition we know that two of the birds now resident on the Cocos-Keeling Islands, the thrush and the white-eye, were introduced intentionally from Christmas Island by George Clunies-Ross, and that he tried to establish the Imperial Pigeon, *Ducula rosacea whartoni* (Sharpe), but failed.

COCOS

The 25 islands of the main atoll vary considerably in size. For the most part they are between 1 and 3 furlongs across from the lagoon shore to the sea, but in length they range from a bare 50 yards to over 6 miles. Each is connected with its neighbours by a barrier of coral reef, except at the north end of the atoll where between Pulo Luar and Pulo Tikus there is a broad, clear channel, deepening at its centre to 5 fathoms. The reef is usually dry, or practically dry, at low water, and by starting on the ebb one can walk in a clockwise direction from Pulo Tikus round to Pulo Panjang. North of the latter is a four-miles stretch of reef running up to the west end of Pulo Luar. It is less well developed than the other sections, and much of it remains covered at all stages of the tide. In addition it is cut by several shallow channels between 1 and 2 miles north

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of Pulo Panjang, through which a boat with a draught of 6-8 feet can be taken at low water, if handled carefully. Pulo Luar, therefore, enjoys a greater degree of isolation than any other island in the main atoll (see map 2).



MAP 2. Sketch map of the main atoll, in the Cocos-Keeling group. The more important islands have been marked with their local Malay names. The uneven, wavy lines show the approximate areas of reef dry or partially dry at low tide. (Outline partly after Wood-Jones, *Coral and Atolls*, 1912, p. 138).

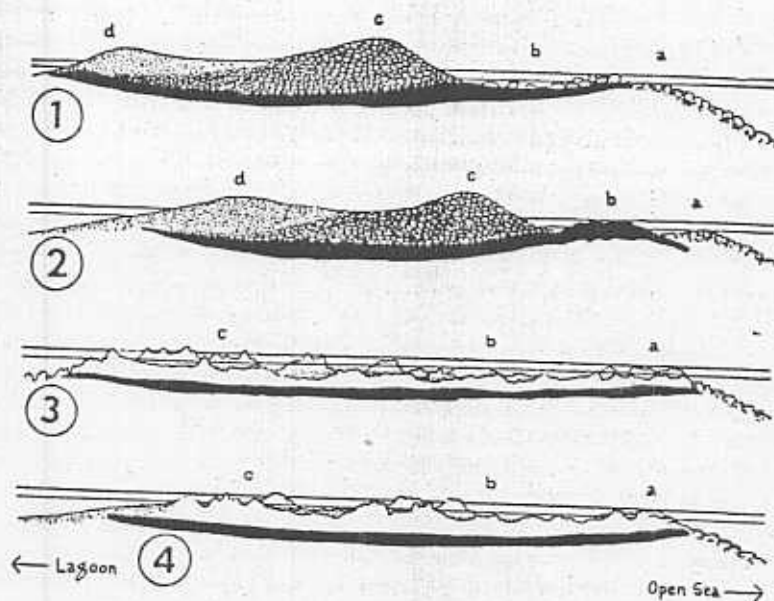
MUS. 22, 1950.

The outer shore of the atoll is protected by an exposed fringe of the barrier which extends seaward for a distance of only 30 to 60 or 70 feet. Beyond this the bottom drops steeply. Even to the north-east, between the Cocos-Keeling Islands and Sumatra, it reaches a depth of over 3,200 fathoms, while between the atoll and Christmas Island it exceeds 3,500 fathoms. The shallowest portion of the surrounding sea is immediately to the north of Pulo Luar, where a narrow submarine ridge, dropping to about 400 fathoms, connects the main atoll with the island of North Keeling.

The greater part of the lagoon, except at its southern end, is thickly strewn with banks of living coral, many of which are barely covered at low water. The only free area of appreciable extent is in the north-eastern corner, to the south of Pulo Tikus. Here there is a broad sandy-bottomed strip with a depth of 5-7½ fathoms, connected with the entrance passage between Pulo Luar and Pulo Tikus by a narrow channel, shoaling to about 4 fathoms and flanked by masses of living coral. The southern half of the lagoon is silting up, and over much of it the coral has been replaced by a fine sand, great expanses of which are dry at low water (*see plate 1, a*). It would seem that in parts at least it is filling in fairly rapidly, the coral banks extending northwards and the sandy silt creeping up on them from behind. When John Clunies-Ross arrived in 1827 in a ship of 428 tons he established his first settlement on the southern portion of Pulo Atas. The move north to the present site on Pulo Selma was a recent event when Darwin visited the group in 1836, and Captain Fitzroy's chart shows two patent channels running down to the south-east corner of the lagoon. These have disappeared completely. At the present time a boat of 428 tons could not even get as far as Pulo Selma, and would probably have to remain in Port Refuge, the clear area immediately to the south of Pulo Tikus. Similarly, Van der Jagt (1831: 308) reports a channel 3-3½ fathoms deep and one-sixteenth of a Dutch mile wide through the reef between Pulo Luar and Pulo Panjang; there is no indication now of a passage of this depth west of Pulo Luar.

The exposed portion of the barrier between the islands at the south end of the lagoon is very wide, but not of great interest. There is little living coral, except along the sea edge, and its fauna is limited. The most noticeable element is probably the asteroid *Culcita novae-guineae*, which is confined almost entirely to this area. The seaward fringe is also a good locality for obtaining *Udang Gala*, *Panulirus fasciatus*, and at low water the shallow pools round Pulo Maria and Pulo-Bélanchi are favourite feeding grounds of the Reef Heron, *Demigretta s. sacra*.

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Diagrammatic cross sections through the upper portion of the barrier, running from the open sea to the lagoon shore, at different points on the atoll. In all cases vertical heights have been exaggerated considerably in relation to horizontal distances. The black bar represents the upper level of the breccia platform, fine stippling sand and the portions marked *c* in sections 1 and 2 coral shingle. The two horizontal lines show the approximate level of the sea at average high and low tides.

(1) is a typical section through the middle portion of Pulo Tikus; *a* is the seaward crest of the barrier, *b* the exposed strip between the edge and the shore of the island, *c* the seaward portion of the island, composed mostly of coral shingle, and *d* its sandy, lagoon shore.

(2) is a section through the eastern end of Pulo Tikus, where the breccia platform has been thrust up on the seaward side of the island and almost fills the hollow usually present in region *b*; the letters *a-d* have the same significance as in (1) above.

(3) is a typical section through the exposed portion of the barrier between Pulo Tikus and Pulo Gangsa (see the short description of this region on page 18, and the illustrations, on plates 3 and 4); the letters used correspond to those in the text, *a* being the seaward rim of the barrier, *b* the middle, slightly depressed section and *c* the raised region on the lagoon side.

(4) shows a typical section through the broad, relatively barren portion of the exposed barrier between the ends of Pulo Atas (South Island) and Pulo Panjang (West Island); the letters *a-c* have the same significance as in (3) above.

The exposed portions of the barrier between the islands are known locally as "the barrier" and the term is used in this limited context in the faunal papers published in this Bulletin.

The barrier becomes increasingly rich in animal life as one moves north up the east side of the atoll, and the most profitable collecting ground is undoubtedly in the section between Pulo Gangsa (immediately to the north of Pulo Selma) and Pulo Tikus. Here it is divided into three well-marked zones—a narrow outer rim (a) built up largely of vertical plates of *Millepora platyphylla* the crests of which are above the water at low tide (see plate 3, a), though they are normally kept moist by the spray from the sea; a broad belt of coral pools (b) little of which is really exposed at low water; and a second broad belt (c) raised slightly higher than (b), and again rich in small pools, but with much of the dividing coral dead. The last zone, (c), passes imperceptibly by a gradual deepening of the water into the lagoon, but in parts along it there are large, still pools with great patches of Staghorn Coral, *Acroporapharaonis*. The outer zone (a) is rich in soft corals, and small nobbly colonies of a species of *Porites* in addition to the ribbed plates of *M. platyphylla*: the predominant echinoid is *Echinothrix diadema* (Linn.), known locally as *Jarum-jaruman panjang*, and the most conspicuous molluscs cowries and the gasteropod *Turbo iajonkairii* Desk. In zone (b), for the most part, *M. platyphylla* occurs in the two forms formerly known as *ulicornis* and *complanata*, both of which are extremely plentiful in the pools, together with *Porites solida*, known locally as *Karang China*, soft corals and several encrusting forms of *Porites* and *Pavonia*. Here also one finds Holothurians, the clam *Tridacna crocea* Lamm. and a wide range of rock-pool fish. In the innermost zone (c) the corals are mostly encrusting forms, together with *Fungia* spp., and occasional small clusters of the more fragile *Stylopora* and *Montipora*. The clam and various Holothurians are very plentiful, together with a large starfish *Linckia* sp., and a number of brittle-stars. This is also the area in which one finds the big *Makanan Kong* (*Acanthaster planci* (Linn.)), and *Heterocentrotus mammillatus* (Linn.) (see plate 3, b.), but there are many fewer kinds of fish, and the temperature of the water at noon is, in most cases, several degrees higher than in the middle zone (b).

The islands are built of coral clinker, thrown up from the edge of the barrier. In most cases they stand on a breccia platform, which runs in from the reef. The majority have fairly steep, shingle beaches on their seaward side, and more gently shelving, sandy beaches towards the lagoon. For the most part they are saucer-shaped, with higher ground round the edge and lower areas in the centre. The differences are, however, slight. Pulo Tikus has a rim 10–15 feet above high tide level, while the centre of the island is only 5–10 feet above the water. The highest point on the atoll is a dune of blown sand

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rising to about 40 feet, at the south-east corner of Pulo Atas, where the prevailing wind strikes it.

There is no real soil on the Cocos-Keeling Islands, but in places the coral fragments are covered with a thin layer composed of decayed vegetable fibres and finely powdered sand. This is useless for most forms of cultivation, but on Pulo Tikus and Pulo Selma it is augmented in selected areas by soil brought from Christmas Island, and here a few fruit trees and some vegetables are grown.

There is no fresh water on the surface of the islands, but on the majority of the larger ones the rain water which filters down between the coral fragments is arrested at a depth of 10-15 feet by the breccia platform. In the case of Pulo Selma, Pulo Luar and at least the south end of Pulo Atas this water exists in great underground reservoirs, uncontaminated by the sea, and can be reached by sinking wells. Unfortunately on Pulo Tikus the sea finds its way into the fresh water catchment; the Cable Station is therefore entirely dependent on roof water, or in an emergency on well-water brought over from Pulo Selma in kerosene tins.

In spite of the paucity of the growing medium the islands are densely covered with vegetation, except where it has been cleared for the settlements. It consists largely of coconut palms, *Cocos nucifera* Linn., which must have been there since before its discovery. Wood-Jones (1912: 17), refuting Dana's statement that "there is no known instance that any island never inhabited has been found supplied with coconut trees", proves that there were palms on the Cocos-Keeling Islands at least two years before it was settled. He overlooks, however a much earlier reference. Dampier, giving his reason for attempting to find the islands in 1688, says "...they designed also to visit the Island Cocos, ... hoping there to find of that Fruit; the Island having its Name from thence." (1697: last lines Chap. 16). On the seaward side the coconut palms are flanked by a thick growth of *Tournefortia*, *Tournefortia argentea* Linn., and *Scaevola*, *Scaevola frutescens* Krause. In a few places there are groves of Sea Trumpet, *Hibiscus tiliaceus* Linn., *Geronggang*, *Cordia subcordata* Lam., Waru Hutan, *Thespesia populnea* Soland, *Melati*, *Guettarda speciosa* Linn., *Calophyllum inophyllum* Linn., or Sea Lettuce, *Pisonia* sp. The majority of these trees are used locally for timber, and must therefore be much less plentiful now than when the islands were first inhabited. There are also a few large patches of *Pemphis*, *Pemphis acidula* Forster, on the lagoon side of the islands at the south end of the atoll. In some places, particularly on Pulo Selma and Pulo Luar, there are open areas covered with a coarse sea grass. Unfortunately this is too salt to be used for grazing. Attempts

have been made to keep goats on it, but they soon became distended with colic and died. A number of different fruit trees have been introduced to these two islands, of which the most important are the Tropical Cherry, *Muntingia calabura* Linn., and the Papaya, *Carica papaya* Linn., known locally as Katis.

The island of Pulo Luar (or Horsburgh) is to some extent different from the others in the main atoll. It has a brackish lagoon, flanked by mangrove, towards its northern end, and two open grass areas on the south side. It has never been exploited fully as a source of coconuts, and for the most part the other vegetation has not been cleared to allow the palms to spread. During the latter part of the last century, the owner of the group used it as a holiday retreat, which he visited to make a change from residence on Pulo Selma. It was therefore one of the islands on which the white-eye *Zosterops natalis*, and the thrush *Turdus javanicus* from Christmas Island, and *Padda oryzivora* from Java, were liberated. For a time a mixed herd of feral Javanese deer, *Cervus unicolor russa* Mull. & Schleg., and *Muntiacus m. muntjak* (Zimm.), was also kept there. Later the island was used as a vegetable farm, run on the labour of the young girls between the ages of fifteen and sixteen, who were sent over from Pulo Selma to prevent them succumbing to their natural inclinations at too young an age. With the latter end in view, no one was allowed to land on the island without a special permit. Accordingly, with its rather more varied vegetation and its natural and enforced isolation, Pulo Luar has easily the largest bird population, in both numbers and kinds, of any of the islands in the main atoll.

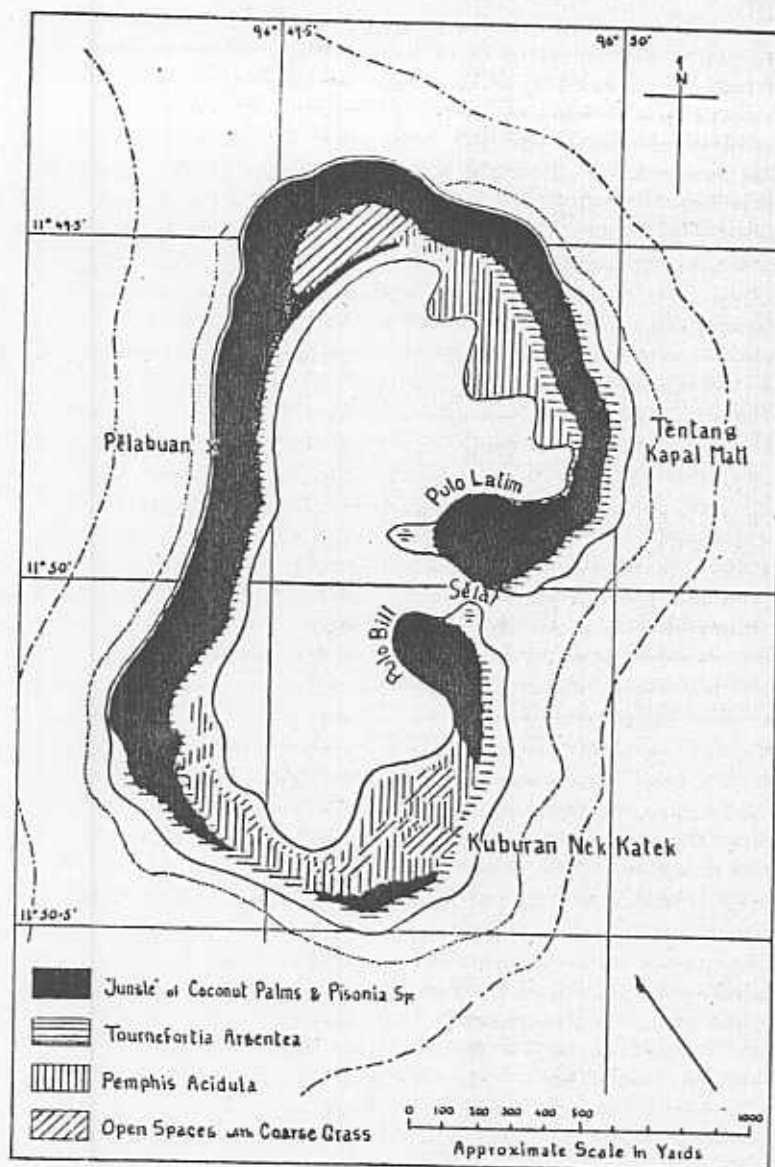
NORTH KEELING

North Keeling, like Cocos, is a true coral island, though there is now little sign of living colonies round the greater part of its coast. Its shape is approximately rectangular, and it is so orientated that its long axis deviates slightly to the east of north. The prevailing wind, therefore, strikes more directly on the east side than on the south. In form it is low and flat. The shore rises fairly steeply to a height of 10 to 15 feet, and from this peripheral ridge the ground slopes gently down to a large, shallow, sandy-bottomed lagoon which occupies the greater part of the interior (see plate 6). The entrance to the lagoon, which is still patent, is on the east or windward side. From this and other considerations in its structure it appears probable that North Keeling was not originally a single island, but that it was formed by the union, on the leeward side, of two small islands. The more southerly of these would seem to have arisen in the area now known as Kuburan Něk Katek, and the other between Pulo Latim and Tentang Kapal Mati (see map 3).

There is only one place at which a landing can be made, a point half way along the west side. Here there is a gap in the surrounding reef, and in calm weather it is possible to beach a surf boat comparatively safely. Suitable conditions for landing may occur at any time of the year, but they are most likely to be encountered between October and January. The uncertainty of being able to reach or leave the island on a chosen day, coupled with the extreme brackishness of the wells that have been sunk, make it virtually uninhabitable. During the prosperous years on the main atoll, from about 1880 to 1915, it was customary to put small parties ashore, during the favourable months, to cut timber for boat building, and gather coconuts for export. Before and since this period, it has only been visited at rare intervals. As a result the timbers of economic importance have been worked less extensively than on Cocos, and it has a rather smaller proportion of coconut palms in relation to the other trees.

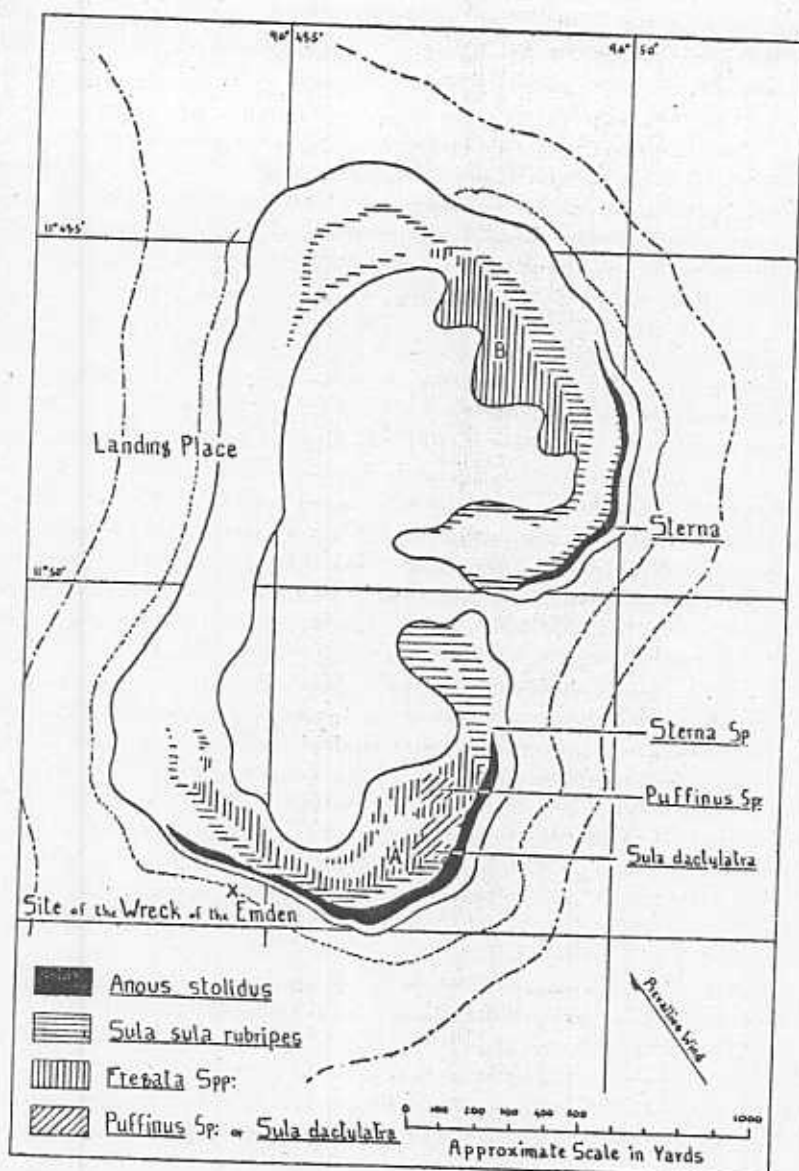
The principal constituents of the terrestrial fauna are the sea birds, which exist in thousands, and crabs, which in a few limited species are abundant. A large tick, feeding normally on the birds (mostly the *Sula* spp.), is also extremely plentiful, and very troublesome when one spends a night on the island. Only a few insects were seen—about six Diptera, made up of a long-legged fly, *Nerius lineolatus* Wied., which is fairly common, some four species of Muscidae and allied families and a mosquito, *Aedes albopictus*; one cricket, an *Ornebius* sp.; a cockroach; only one Hymenoptera, a long-legged fawn coloured ant; about three beetles; and four Lepidoptera, *Hypolimnas b. bolina* (Linn.), *Ophiura melicerta* Fabr., *Utetheisa lotrix* Cr., and *Zinckenia nigerrimalis* Hamps. Three species of spider were found on the island, a small wood-louse and a terrestrial mollusc, but there seem as yet to be no centipedes, no millipedes, no termites and no earthworm, though examples of each are well-distributed and in some cases plentiful on the main atoll.

Broadly speaking the vegetation falls into four distinct, clear-cut groupings (see map 3). The most conspicuous of these (see plate 5, a) is composed largely of Ampol, *Pisonia grandis* R. Br., and the Coconut Palm, *Cocos nucifera* Linn.; it also contains small amounts of Kayu Dédap, *Erythrina variegata* Linn. and Gëronggang, *Cordia subcordata* Lamm. It begins near the south-west corner of the island, and runs as a broad belt, about 150 yards wide, up the west side and round the north end down to Pulo Latim; a second patch of it covers Pulo Bill, and there is a narrow strip at the south-east corner of the island. The second unit consists of a single species, *Tournefortia argentea* Linn., which forms a fringe of varying depth, round the edge of the *Cocos-Pisonia* belt; where the latter is



MAP 3. Sketch map showing the distribution of the principal units of vegetation on the island of North Keeling; see descriptive note on page 21, and plates 5 and 6.

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MAP 4. Sketch map showing the distribution of the breeding areas of the commoner sea birds on the island of North Keeling. *Puffinus* sp. = *Puffinus pacificus chlororhynchus* Lesson. *Sterna* sp. = *Sterna fuscata nubilosa* Sparrm. The *Fregata* are races of *F. minor* and *F. ariel*.

Mus. 22, 1950.

absent, along the south coast of the island and in the region of Kuburan Nēk Katek, it continues the line on its own. In addition there are two broad patches of the tea-shrub, *Pemphis acidula* Forster, round the south-east and north-east corners of the lagoon. Finally there are several areas where trees and shrubs are absent, and the vegetation consists only of a coarse grass and a species of *Sesuvium*; the most prominent of these are a large patch at the north-west corner of the island, and two near the *Pemphis* zone at the south-east corner. As the second map of the island (map 4) shows, the breeding areas of the various sea birds are determined by the distribution of the zones of vegetation coupled with an apparent reluctance to make use of the lee side of the island.

CLIMATE

The climate is pleasant. The normal wind is the south-east trade, which blows fairly steadily for the greater part of the year. There are occasional periods of dead calm, and there may be two or three storms with velocities exceeding 35 knots, but in general the wind varies between 1 and 4 on the Beaufort scale. Both calms and high winds seem to be most likely to occur in October/December and May/July. On these occasions the wind usually veers to the north, dropping in intensity as it does so until it virtually disappears. Bad weather, if it is coming, arrives as it backs or continues to its normal position.

The temperature appears to be fairly constant year by year, with January and February the two warmest months (mean maximum 87.2° F. and 87.0° F., average for the years 1930-39), and July and August the two coolest ones. The rainfall is rather more variable and since records were first kept at the Cable Station in 1902, every month has been the wettest in at least one year, and all except February and June the driest. The extent of the variation is shown also by the following table, which gives the highest and lowest rainfalls recorded for each month over the period 1902-1938; the last column gives the average precipitation for the month in question over the same period.

Month	Greatest Precipitation Recorded	Least Precipitation Recorded	Average 1902-38
January ..	15.04" in 1904	nil in 1923	5.41"
February ..	25.97" in 1935	1.46" in 1931	7.48"
March ..	28.11" in 1913	.43" in 1904	8.64"
April ..	22.66" in 1934	1.52" in 1906	10.13"
May ..	22.22" in 1919	.74" in 1935	7.54"
June ..	18.04" in 1903	1.40" in 1902	8.99"
July ..	35.96" in 1908	1.23" in 1918	8.81"
August ..	16.74" in 1920	1.13" in 1935	4.90"
September ..	21.31" in 1909	.21" in 1938	3.35"
October ..	32.04" in 1910	.15" in 1904	3.31"
November ..	19.30" in 1933	nil in 1923	4.05"
December ..	20.19" in 1922	.11" in 1927	4.42"

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COCOS-KEELING ISLANDS: METEOROLOGICAL READINGS, DECEMBER, 1940 TO NOVEMBER, 1941

	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.
Total Rainfall ..	2.70	2.74	4.04	4.34	10.1	16.0	14.3	6.94	2.65	15.9	2.12	..
in inches ..	(4.57)	(5.57)	(8.86)	(7.60)	(11.9)	(6.72)	(7.37)	(5.51)	(5.14)	(2.10)	(2.55)	(5.62)
Days of Rain ..	10	7	15	23	22	26	23	25	22	28	13	..
	(13)	(12)	(15)	(17)	(18)	(18)	(18)	(17)	(17)	(13)	(10)	(12)
Mean Temperature, 9 a.m. ..	81.9	84.1	83.3	82.9	82.5	81.8	80.1	80.2	79.9	79.3	80.2	..
Mean Temperature, 3 p.m. ..	85.5	88.5	87.9	87.7	85.4	85.2	82.8	82.2	82.4	81.1	83.1	..

The figures in brackets below the first two items represent the average of the readings for the ten years 1931 to 1940. Compiled from data recorded at the Cable Station on Pulo Tikus by permission of the Manager, October 1941.

The highest yearly total in this period was a fall of 115.11" in 1910, and the lowest a fall of 43.30" in 1918; the average annual precipitation was 77.01". In spite of these variations, however, one can say that normally the greater part of the rain falls in the first six months of the year, and that September and October are usually very dry. In common with all atolls, there is little if any dew precipitated in dry weather and almost uninterrupted sunshine throughout the day. As a result the vegetation becomes very parched after only a few weeks of relative drought. There is, therefore, a marked dry season round the months September-October, but the same conditions also begin to manifest themselves towards the end of a spell of scanty rainfall at any time of the year.

The meteorological readings for the period of my stay on the islands, when the accompanying collections were made, are given on page 25.

APPENDIX

(A) De facto owners of the Cocos-Keeling Islands.

1825. *Captain Le Cour.*
Master of the brig *Mauritius*.¹
- 1827-?1830. *Alexander Hare and John Clunies-Ross.*
- ?1830-1854. *John Clunies-Ross.*
Born on Yell, in the Shetlands, August, 1785.
Married Elizabeth Dymoke, of London.
Died on the Cocos-Keeling Islands, in 1854.
- 1854-1871. *John George Clunies-Ross.*
Eldest son of the above.
Born in London, ?1809.
Married S'pia Dupong of Java, in 1841.
Died on the Cocos-Keeling Islands, in 1871.
- 1871-1910. *George Clunies-Ross.*
Eldest son of the above.
Born on the Cocos-Keeling Islands, in 1842.
Married (a) Lini, in 1868, (b) Ayesha, in 1895.
Died in the Isle of Wight, 7 July, 1910.
- 1910-1944. *John Sydney Clunies-Ross.*
Second son of the above.
Born on the Cocos-Keeling Islands, 13 November, 1868.
Married Rose Alexander Nash.
Died on the Cocos-Keeling Islands, 4 August, 1944.
1944. *John Cecil Clunies-Ross.*
Eldest son of the above.
Born on the Cocos-Keeling Islands, 9 November, 1928.

¹ It seems probable that Le Cour's occupation of the islands was involuntary. He left the names of himself, his crew and his ship carved on the trunks of coconut palms, but the party does not appear to have been on the atoll for long. He is usually regarded as the first settler, but it seems more likely that the *Mauritius* was wrecked there, as the brig *Sir Francis Nicholas Burton*, from London, was in 1826.

(B) Cyclones.

The Cocos-Keeling Islands are subject to severe cyclones at fairly wide intervals. The following have been recorded during the last hundred years.

- c. 1862. Wood-Jones (1912, pp. 29 and 205) refers to a cyclone which wrecked the settlement in 1862. The Eastern Archipelago Pilot (1934, p. 19) gives two about this period, one in March 1861, and the second in 1863.
- 1867. There was a cyclone on January 28, 1876, whose effects are described by Forbes (1885, pp. 18-20). The barometer is said to have dropped to 26.5 inches. It was accompanied by a tidal wave which destroyed the store-houses, oil mills and most of the houses in the kampong. Corrugated iron from some of the roofs was carried for several miles by the wind. At the same time there was also a slight earthquake, as a result of which a black sulphurous fluid came up in the southern part of the lagoon, and killed nearly all the fish and coral in this area.
- 1893. On February 4, 1893, there was another cyclone, with the wind mostly from the north and north-west. The storm lasted for two days. Over 30,000 coconut palms are said to have been uprooted, in addition to other damage, during this period (Wood-Jones, 1912, p. 205).
- 1902. On March 4, 1902, there was a fourth cyclone, with the wind veering from south-west to north-north-west. The storm appears to have lasted for only a few hours, and to have been less violent than its predecessors. Nevertheless according to Wood-Jones, over 300,000 palms were destroyed.
- 1909. The last serious storm was on November 27, 1909. The peak lasted about six hours, during which the wind blew first from the south, and then, after half an hour's calm, equally hard from the north. The barometer dropped to 27.92 inches. It again was accompanied by a tidal wave, which left only five buildings standing. According to George Clunies-Ross about 800,000 coconut palms were uprooted or decapitated: the Eastern Archipelago Pilot (1934, p. 19) puts the figure lower, at 200,000.

(C) Selected Bibliography.

(1) COCOS-KEELING ISLANDS.

The following are the principal original publications relating to the Cocos-Keeling Islands, excluding the reports published on the tours of inspection by Straits settlements officers and naval commanders.

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- FORBES, H. O. 1885. *A Naturalist's Wanderings in the Eastern Archipelago*, pp. 11-47. London.
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- . 1949. The Birds of the Cocos-Keeling Islands, *Ibis*, 91 (2), pp. 221-243.
- . 1949. Boats and Fishing on the Cocos-Keeling Islands, *Journ. Roy. Anthropol. Inst.*, 76 (1), 1946, pp. 13-23.

- GUPPY, H. B. 1889. The Cocos-Keeling Islands, *Scottish Geographical Magazine*, 5 (6, 9 and 11).
- KEATING, A. S. 1846. quoted in A Voyage Round the World, James Holman, 4, pp. 374-388. London.
- VAN DER JAGT, H. 1831. Beschrijving der Kokos—of Keeling eilanden, *Verh. Batav. Gen. v. Kunsten en Wetenschappen*, 13, pp. 293-322.
- WOOD-JONES, F., et al. 1909. The Fauna of the Cocos-Keeling Islands, *Proc. Zool. Soc. Lond.*, 1909 (1), pp. 132-160.
- . 1912. Coral and Atolls, 2nd ed. London. (includes a reprint of the faunal papers in the *Proc. Zool. Soc. Lond.* of 1909).

The following official reports were published on the tours of inspection by government officers and naval commanders between 1885 and 1912 inclusive. The lists below give only the name of the recording officer, and the date of his visit.

(i) Published in *Papers relating to the Cocos-Keeling and Christmas Islands*, March 1897.

E. W. Birch	..	..	1885 (August)
Lt. H. R. Adams (H.M.S. <i>Espoir</i>)	..	..	1885 (August)
A. P. Talbot	..	..	1886 (August)
R. S. O'Connor	..	..	1887 (September)
N. P. Trevenen	..	..	1888 (June/July)
Lt. W. Maitland Dougall (H.M.S. <i>Rattler</i>)	..	..	1889 (August)
Henry N. Ridley	..	..	1890 (July)
Walter Egerton	..	..	1891 (August)
Com. L. M. Bell (H.M.S. <i>Plover</i>)	..	..	1892 (June)
A. R. Venning	..	..	1893 (June)
Hugh Clifford	..	..	1894 (June)
Arthur Keyser	..	..	1896 (June)

(ii) *Colonial Reports* subsequent to 1896, issued separately.

A. J. Leach	..	..	1897 (July)
R. J. Farrer	..	..	1898 (September)
A. S. Baxendale	..	..	1899 (August/Sept.)
W. Langham-Carter	..	..	1901 (September)
L. H. Clayton	..	..	1902 (July)
A. S. Baxendale	..	..	1903 (July)
Com. D. St. A. Wake (H.M.S. <i>Rinaldo</i>)	..	..	1904 (June)
C. Maxwell	..	..	1911
Herbert C. Robinson	..	..	1912 (October)

(2) CHRISTMAS ISLAND.

The principal accounts of the fauna of Christmas Island occur in "A Monograph of Christmas Island (Indian Ocean)" by C. W. Andrews, 1900, B.M. (N.H.) London, and *Bulletin of the Raffles Museum*, No. 19, 1947. A full bibliography of the papers relating to Christmas Island is given in an appendix to "The Early History of Christmas Island in the Indian Ocean", by C. A. Gibson-Hill, *Journ. Malay Br. Roy. Asiat. Soc.*, 22 (1), 1949, pp. 67-93.



Landscape at the south end of the main atoll (Cocos).



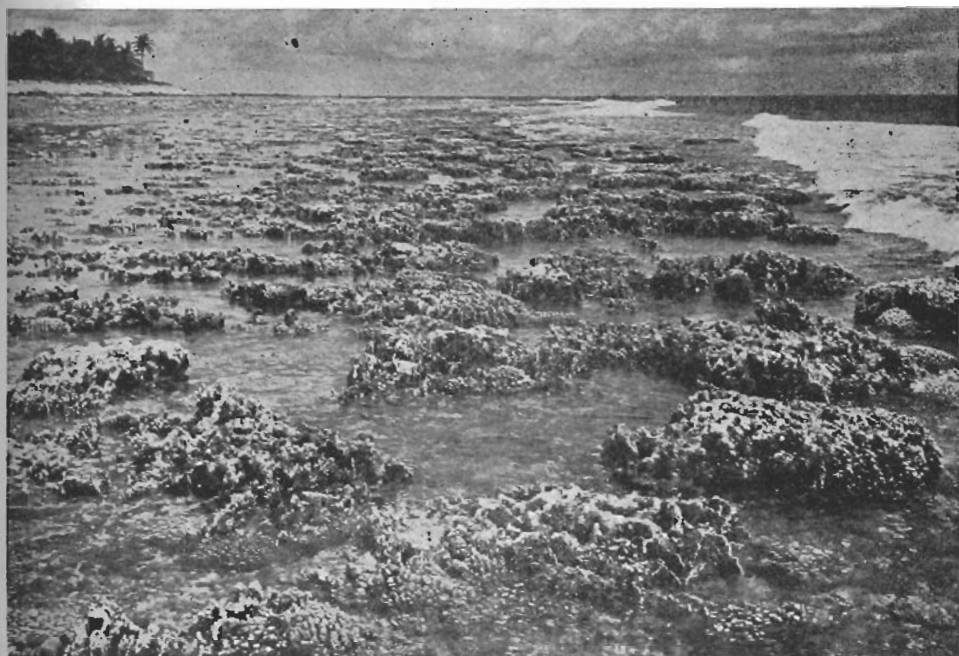
The lagoon on Pulo Luar, main atoll (Cocos).



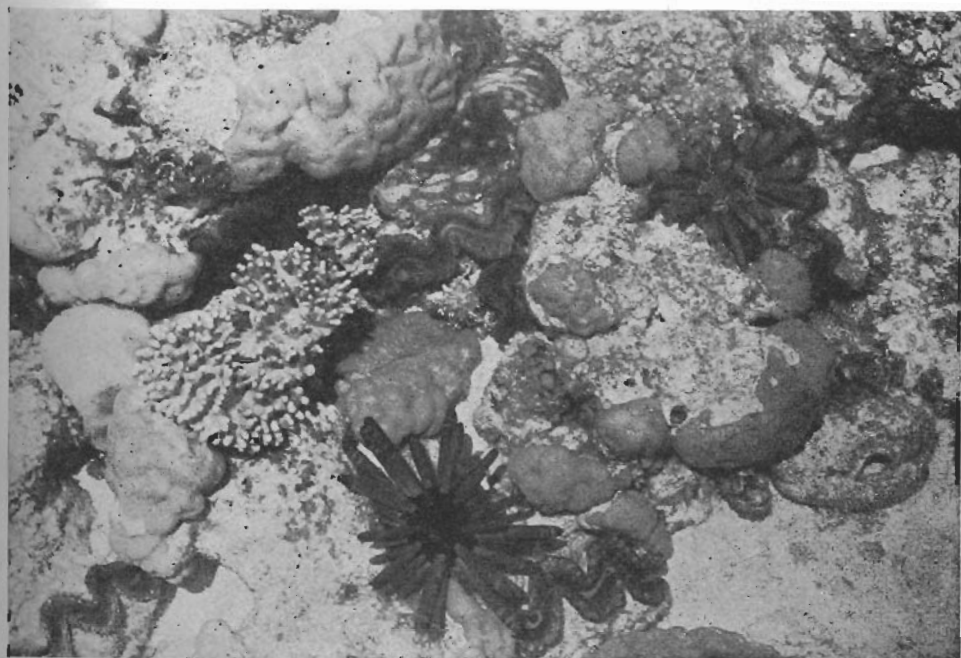
The north-east corner of the main atoll, looking from Pulo Tikus towards Pulo Gangsa and Pulo Selma.



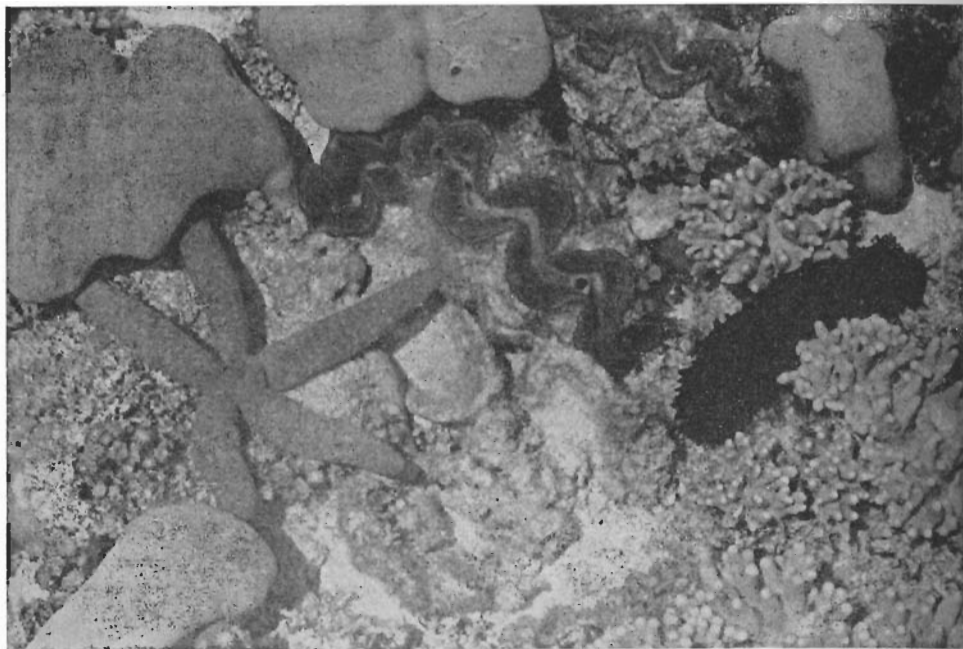
A landscape in the main atoll: Pulo Gangsa from Pulo Tikus.



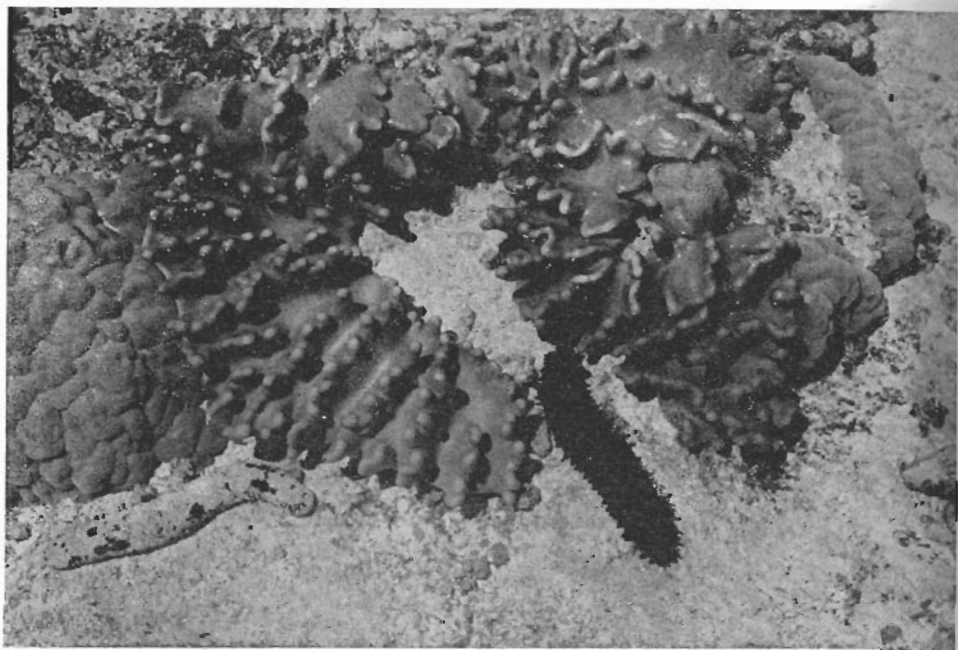
Outer edge of the barrier (a) between Pulo Gangsa and Pulo Tikus.



Pool in the inner section of the barrier (c) between
Pulo Gangsa and Pulo Tikus.



Clams, the large blue starfish, soft corals and a holothurian in a pool in the middle section of the exposed barrier (*b*), between Pulo Gangsa and Pulo Tikus, on the Cocos atoll.



Soft corals and holothurians in a pool immediately behind the outer, seaward edge of the barrier flat between Pulo Gangsa and Pulo Tikus, on the Cocos atoll.



Vegetation on North Keeling—the *Pisonia* belt.



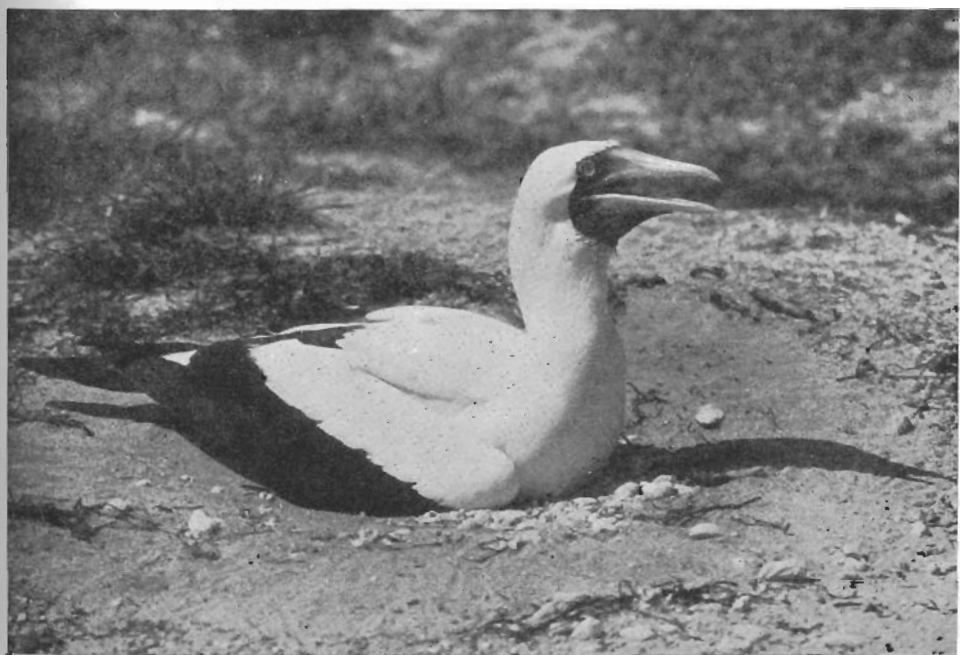
Vegetation on the main atoll—Coconut palms at the south end of Pulo Atas.



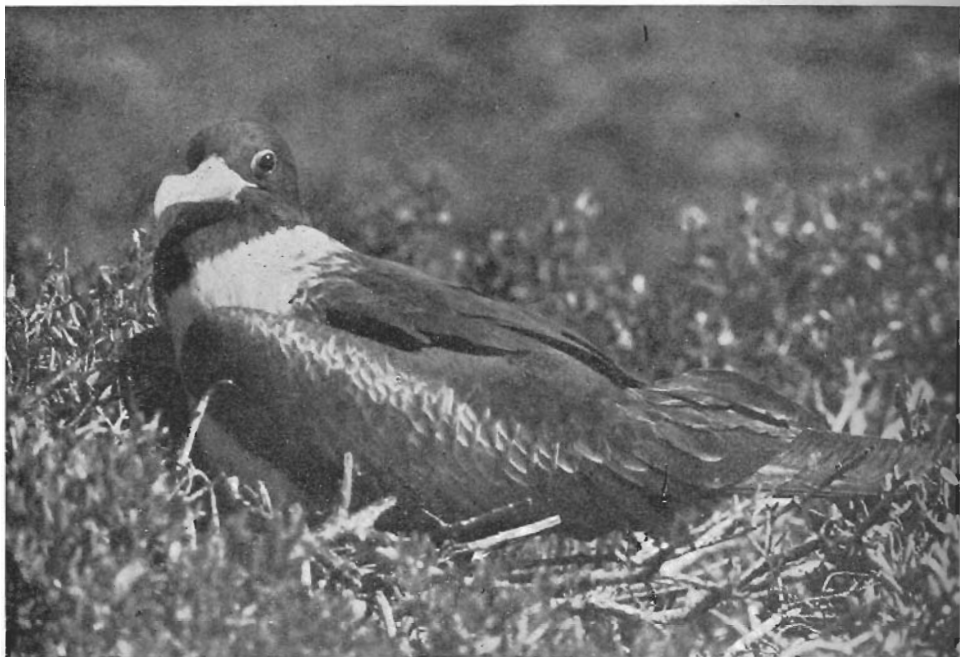
The island of North Keeling.



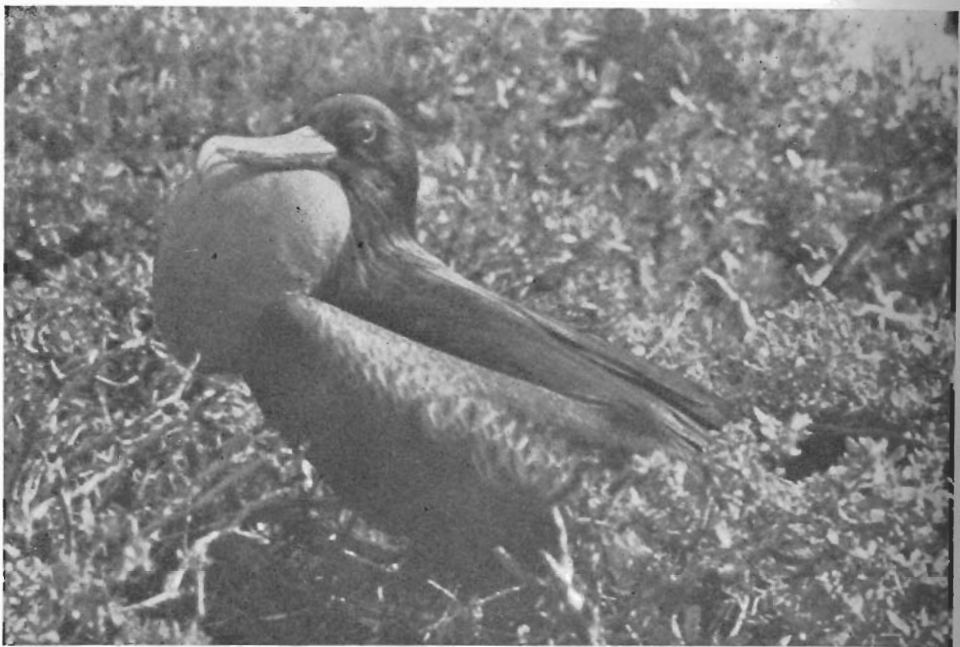
The White Tern in flight.



The Masked Booby on its nest, North Keeling.



Female Lesser Frigate-bird on its nest, North Keeling.



Male Least Frigate-bird, with its gular pouch distended, North Keeling.